1. A controller comprising a base, a handle [platform], [means for mounting said platform for] a support providing said handle with a range of movement in a plane in each of two different directions, a first magnetic force applying means including a first magnet means mounted on said base and a first cooperating magnetic force generating means coupled to said handle [mounted on and moveable with said platform] in position to interact with said first magnet means, a second magnetic force applying means including a second magnet means mounted on said base and a second cooperating magnetic force generating means coupled to said handle [mounted on and moveable with said platform] in a position to interact with said second magnet means, said first and said second magnet means being fixed relative to each other on said base and said first and second cooperating magnet force generating means being fixed relative to each other on said platform, said first force applying means being positioned and constructed to controllably apply selected forces to said handle [platform] in one of said two different directions and said second force applying means being constructed and positioned to controllably apply selected forces to said handle [platform] in the other of said two different directions and control means to selectively control said first and said second force applying means to generate said selected forces.

2. A controller as defined in claim 1 wherein said two directions are mutually perpendicular.

3. A controller as defined in claim 1 further comprising a sensor means for sensing the position of said handle [platform] relative to said base.

4. A controller as defined in claim 3 wherein said sensor means comprises a transparent grid coupled to said handle [mounted on and moveable with said platform] and a light source and a detector means fixed relative to said base in positions wherein light from said source passes through said grid and is detected by said detector means.

5. A controller as defined in claim 2 further comprising a sensor means for sensing the position of said handle [platform] relative to said base.

6. A controller as defined in claim 5 wherein said sensor means comprises a transparent grid coupled to said handle [mounted on] and moveable with said [platform] handle and a light source and a detector means fixed relative to said base in

positions wherein light from said source passes through said grid and is detected by said detector means.

7. A controller as defined in claim 2 wherein said first cooperating magnet force generating means including a first coil means position to interact with said first magnet means when a current is applied to said first coil means, and said second magnetic force generating means including a second cooperating coil means in a position to interact with said second magnet means when a current is applied to said second coil means, said first magnet means and said first cooperating coil means of said first force applying means being shaped and positioned so that in any position of said handle [platform] within said range said coil may be controlled to apply said selected forces between each of said first and second cooperating coil means and its respective magnet means and wherein said control means selectively applies current to said first and said second cooperating coil means to generate said selected forces.

8. A controller as defined in claim 7 wherein the projected area of a field generated by said first magnet means onto said first cooperating coil means is substantially constant so that the application of a selected current to said first cooperating coil means generates the same force between said first magnet means and said first cooperating coil means regardless of the position of said handle [platform] within said range of movement, said second magnet means and said second cooperating coil means of said second force applying means being shaped and positioned so that in any position of said handle [platform] within said range the projected area of a field generated by said second magnet means onto said second cooperating coil means is substantially constant so that the application of a selected current to said second cooperating coil means generates the same force between said second magnet means and said second cooperating coil means regardless of the position of said handle [platform] within said range.

9. A controller as defined in claim 8 wherein said first cooperating coil means comprises a first elongated substantially planar coil having its major axis extending substantially parallel to said plane and to one of said pair of mutually perpendicular directions and said second cooperating coil means comprises a second elongated substantially planar coil having its major axis substantially parallel to said plane and said other of said mutually perpendicular directions.

10. A controller as defined in claim 5 wherein said first cooperating magnet force generating means including a first coil means position to interact with said first

magnet means when a current is applied to said first coil means, and said second magnetic force generating means including a second cooperating coil means in a position to interact with said second magnet means when a current is applied to said second coil means, said first magnet means and said first cooperating coil means of said first force applying means being shaped and positioned so that in any position of said handle [platform] within said range said coil may be controlled to apply said selected forces between each of said first and second cooperating coil means and its respective magnet means and wherein said control means selectively applies current to said first and second cooperating coil means to generate said selected forces.

11. A controller as defined in claim 10 wherein the projected area of a field generated by said first magnet means onto said first cooperating coil means is substantially constant so that the application of a selected current to said first cooperating coil means generates the same force between said first magnet means and said first cooperating coil means regardless of the position of said handle [platform] within said range of movement, said second magnet means and said second cooperating coil means of said second force applying means being shaped and positioned so that in any position of said platform within said range the projected area of a field generated by said second magnet means onto said second cooperating coil means is substantially constant so that the application of a selected current to said second cooperating coil means generates the same force between said second magnet means and said second cooperating coil means regardless of the position of said handle [platform] within said range.

12. A controller as defined in claim 11 wherein said first cooperating coil means comprises a first elongated substantially planar coil having its major axis extending substantially parallel to said plane and to one of said pair of mutually perpendicular directions and said second cooperating coil means comprises a second elongated substantially planar coil having its major axis substantially parallel to said plane and said other of said mutually perpendicular directions.

13. A controller as defined in claim 6 wherein said first cooperating magnet force generating means including a first coil means position to interact with said first magnet means when a current is applied to said first coil means, and said second magnetic force generating means including a second cooperating coil means in a position to interact with said second magnet means when a current is applied to said second coil means, said first magnet means and said first cooperating coil means of said first force applying means being shaped and positioned so that in any position of

said [platform] handle within said range said coil may be controlled to apply said selected forces between each of said first and second cooperating coil means and its respective magnet means and wherein said control means selectively applies current to said first and said second cooperating coil means to generate said selected forces.

14. A controller as defined in claim 13 wherein the projected area of a field generated by said first magnet means onto said first cooperating coil means is substantially constant so that the application of a selected current to said first cooperating coil means generates the same force between said first magnet means and said first cooperating coil means regardless of the position of said [platform] handle within said range of movement, said second magnet means and said second cooperating coil means of said second force applying means being shaped and positioned so that in any position of said [platform] handle within said range the projected area of a field generated by said second magnet means onto said second cooperating coil means is substantially constant so that the application of a selected current to said second cooperating means generates the same force between said second magnet means and said second cooperating coil means regardless of the position of said [platform] handle within said range.

15. A controller as defined in claim 14 wherein said first cooperating coil means comprises a first elongated substantially planar coil having its major axis extending substantially parallel to said plane and to one of said pair of mutually perpendicular directions and said second cooperating coil means comprises a second elongated substantially planar coil having its major axis substantially parallel to said plane and said other of said mutually perpendicular directions.

16. A controller as defined in claim 9 wherein said first magnet means and said second magnet means each comprises a pair of permanent magnet means, one permanent magnet means of each said pair located on one side of its said cooperating coil means and the other permanent magnet means of each said pair of permanent magnet means located on the side of its said cooperating coil means opposite its respective said one permanent magnet means.

17. A controller as defined in claim 16 wherein each said permanent magnet means comprises a pair of permanent magnets arranged in spaced parallel relationship with their magnetic poles facing in opposite directions and with their polar axes substantially parallel to the plane of said planar coils.

18. A controller as defined in claim 17 wherein said polar axis of each said permanent magnet means is substantially parallel to said major axis of its respective cooperating planar coil.

Sub a1

19. A human interface device for enabling manual interactions with application software running on a host computer, said software providing images displayed on a computer display, said device comprising:

(a) a handle to be manipulated manually by a user;

(b) at least one actuator coupled to said handle;

(c) a support mechanism which supports said handle while allowing a plurality of degrees of freedom of said handle with respect to an origin;

(d) a sensor that produces a locative signal responsive to and corresponding with the position of said handle; and

(e) a microprocessor separate from said host computer and coupled to said host computer by a communication bus, said microprocessor also coupled to said sensor and to said actuator,

said microprocessor receiving said locative signal from said sensor and sending a representation thereof over said communication bus to said host computer, said microprocessor calculating, locally to said interface device, forces to be applied by said actuator upon said handle in parallel with said application software running on said host computer, said locally-calculated forces corresponding to the interactions of graphical objects displayed by said host computer.

20. A device as recited in claim 19 wherein said microprocessor receives force information from the host computer.

21. A device as recited in claim 19 wherein said support mechanism allows linear displacement between said handle and said origin.

22. A device as recited in claim 19 wherein said sensor is an optical sensor system that includes a light source that moves relative to a detector when said handle is moved, said light source projecting light upon said detector.

23. A device as recited in claim 22 wherein said sensor is an optical sensor system that includes a light source that moves when said handle is moved, projecting light upon a detector that is fixed with respect to said origin.

24. A device as recited in claim 23 wherein said detector detects motion of said light source in two mutually perpendicular directions.

25. A device as recited in claim 19 further comprising:

a switch capable of being in an on state and an off state, said switch being coupled to said microprocessor such that said microprocessor can detect said states of said switch and generate a corresponding signal for receipt by said host computer.

26. A device as recited in claim 25 wherein said switch comprises a button.

27. A device as recited in claim 19 wherein said memory also stores values that are representative of the locations of images displayed by said host computer.

28. A device as recited in claim 27 wherein said locations include the locations of icons displayed by said host computer.

29. A device as recited in claim 19 wherein said handle is a joystick.

30. A device as recited in claim 19 wherein said handle is a mouse.

31. A device as recited in claim 19 wherein said microprocessor receives display information from said host computer over said communication bus.

32. A device as recited in claim 19 wherein said forces include a viscous drag force.

33. A device as recited in claim 19 wherein said forces include an attractive force.

34. A device as recited in claim 33 wherein said attractive force is used to assist a user in positioning a displayed cursor into a displayed icon.

35. A device as recited in claim 19 wherein said forces are correlated with a displayed cursor being drawn over a displayed graphical menu.

36. A device as recited in claim 19 wherein said forces are applied when a boundary region is entered or exited by a displayed cursor.

Sub A3

37. A device as recited in claim 19 wherein said at least one actuator is a flat coil actuator.

38. A device as recited in claim 37 wherein the magnet associated with said at least one flat coil actuator is fixed with respect to said origin and wherein the coil moves with respect to said origin.

39. A device as recited in claim 19 wherein said microprocessor receives code over a communication bus from a host computer and executes said code, said communication bus including a serial interface bus.

40. A device as recited in claim 19 wherein said handle is moveable in a planar, two degree of freedom workspace.

41. A device for use in conjunction with a host computer including a computer display, said device comprising:

a handle;

a support mechanism coupled to and supporting said handle while allowing motion of said handle in a plurality of degrees of freedom;

a sensor coupled to at least one of said handle and said support mechanism and that produces a locative signal responsive to and corresponding with a position or motion of said handle;

an embedded microcontroller within a housing of said device and coupled to said sensor such that said microcontroller can read said locative signal from said sensor, said microcontroller running a program contained, at least in part, in memory coupled to said microcontroller,

said microcontroller providing information for use by said host computer running an application program which can provide images on said computer display, said application program providing force information which can be communicated to said microcontroller over a communication bus, wherein said program running on the microcontroller and said application program running on the host computer are running in parallel; and

an actuator coupled to and controlled at least in part by said microcontroller for providing force sensations to said user which correspond with said images displayed on said computer display.

42. A device as recited in claim 41 wherein said memory also stores location information which corresponds with image data from a computer display coupled to said host computer.

43. A device as recited in claim 42 wherein said location information includes information relating to the location of an icon on said graphical display.

44. A device as recited in claim 42 wherein said location information includes information relating to the location of a window on said graphical display.

45. A device as recited in claim 42 wherein said location information includes information relating to the location of a graphical button on said graphical display.

46. A device as recited in claim 42 wherein said images include a cursor interacting with another object displayed on said computer display.

47. A device as recited in claim 46 wherein said cursor interacts with an icon image displayed on said computer display.

Sub a4

48. A device as recited in claim 42 wherein said handle is capable of moving in only two degrees of freedom.

49. A device as recited in claim 48 wherein said two degrees of freedom are linear degrees of freedom.

50. A force feedback mouse for use with a host computer running an application program which displays images on a display apparatus, said mouse enabling a user to control the position of a cursor displayed on said display apparatus and enabling said user to feel tactile sensations in accordance with the position of said cursor, said force feedback mouse comprising:

a handle that can be moved by a user in a plurality of degrees of freedom with respect to an origin;

a sensor that provides position information responsive to and corresponding with a user's manipulation of said handle with respect to said origin;

at least one button that provides state information;

at least one actuator coupled to said handle for applying forces to said handle;

a microprocessor separate from said host computer, coupled to said sensor, to said button, and to said at least one actuator, said microprocessor receiving non-real

time commands from said host computer, responding to said commands, and controlling the forces applied by said at least one actuator on said handle; and

a communication bus for coupling said microprocessor to said host computer, said bus being adapted to convey said non-real time commands from said host computer to said microprocessor and to convey data representative of said handle position and said button state to said host computer, wherein said application program is running on said host computer in parallel with said control of forces by said microprocessor.

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51. A force feedback mouse as recited in claim 50 wherein said microprocessor calculates force feedback forces.

52. A force feedback mouse as recited in claim 50 wherein said handle is moveable in a plane with respect to said origin.

53. A force feedback mouse as recited in claim 52 wherein said handle is also moveable along a z-axis that is approximately perpendicular to said plane.

54. A force feedback mouse as recited in claim 53 wherein said force is applied along said z-axis.

55. A force feedback mouse as recited in claim 50 wherein said forces are applied to correspond with a displayed cursor interacting with a displayed menu.

56. A force feedback mouse as recited in claim 50 wherein said forces are applied to correspond with a displayed cursor interacting with a displayed button.

57. A force feedback mouse as recited in claim 50 wherein said forces are applied to correspond with a displayed cursor interacting with a displayed window.

58. A force feedback mouse as recited in claim 50 wherein said forces are applied to correspond with a displayed cursor interacting with a displayed icon.

59. An interface device for use with a host computer displaying a graphical application on a display device, said host computer displaying, executing, and updating graphical objects in response to user manipulation of said interface device and commanding force feedback sensations in response to said user manipulation and in coordination with said graphical objects, the interface device comprising:

a physical object grasped and manipulatable by a user;

at least one actuator coupled to said physical object for receiving a force control signal and imparting motion along at least one degree of freedom of said physical object and in accordance with said force control signal;

a sensor that detects motion of said physical object along said degree of freedom and outputs signals relating to the position of said physical object;

a user-adjustable switch apparatus providing a state signal representing a state of said switch apparatus; and

a microprocessor local to said interface apparatus, separate from said host computer, and coupled to said host computer, to said sensor, and to said switch apparatus, said microprocessor receiving

non-real time commands from said host computer,

said state signal from said switch apparatus, and

said signals from said sensor,

said microprocessor executing a process in parallel with said host execution of said graphical application and providing said force control signal to said at least one actuator in accordance with and corresponding to control movements made by the user which affect said graphical objects displayed by said display device;

said actuator thereby applying force feedback sensations to said physical object.

60. The interface device claimed in claim 59 wherein the information sent by said host computer to said microprocessor comprises force information.

61. A device for use in conjunction with a host computer including a computer display, said device comprising:

a handle;

a support mechanism coupled to and supporting said handle while allowing motion of said handle in a plurality of degrees of freedom;

a sensor coupled to at least one of said handle and said support mechanism and that produces a locative signal responsive to and corresponding with a position or motion of said handle;

an embedded microcontroller within a housing of said device and coupled to said sensor such that said microcontroller can read said locative signal from said sensor, said microcontroller running a local program contained, at least in part, in memory coupled to said microcontroller,

said microcontroller providing sensed information for use by said host computer running a program which can provide images on said computer display, said

program providing tactile information which can be communicated to said microcontroller over a communication bus, wherein said local program running on the microcontroller and said program running on the host computer are running in parallel; and

an actuator coupled to and controlled at least in part by said microcontroller for providing tactile sensations to said user which correspond with said images displayed on said computer display.

62. A device as recited in claim 61 wherein said sensed information sent to said host computer includes movement data representative of motion of said handle and button status data representative of a state of at least one button provided on said device.

63. A method for controlling a force feedback interface device using a host computer, said interface device manipulated by a user, a display device coupled to said host computer displaying a graphical user interface including images and updating said graphical user interface in response to said manipulation of said interface device, said interface device conveying force feedback sensations to said user in response to said manipulations, the method comprising:

sending a position signal to said host computer, said position signal including information representative of the motion or position of a handle of said interface device in a plurality of degrees of freedom with respect to a surface, said handle being grasped by said user, wherein said host computer updates the location of a cursor within said graphical user interface in response to said position signal;

receiving position information from said host computer by a microprocessor local to said force feedback interface device, said microprocessor executing a local process in parallel with said graphical user interface executed by said host computer, said local process calculating force feedback forces with respect to said position information; and

outputting a signal from said microprocessor to one or more actuators, said signal controlling the direction and magnitude of a force to be applied by said one or more actuators on said handle grasped by said user.

64. A method as recited in claim 63 wherein a sensor signal is input to said microprocessor, said microprocessor calculating said position signal based on said sensor signal, said microprocessor sending said position signal to said host computer.

65. A method as recited in claim 63 wherein said handle includes a joystick that can be moved by said user in two degrees of freedom.

66. A method as recited in claim 64 wherein said graphical user interface provides graphical objects for interfacing with an application program running on said host computer, said graphical objects including an icon, a window, and a menu.

Sub a7

67. A method for providing force feedback to a user of a force feedback interface device and of a graphical user interface displayed by a host computer, comprising:

receiving on a microprocessor local to said interface device a locative signal representing a position of a handle in one or more degrees of freedom, said locative signal being used to determine a location of a user-controlled cursor within a graphical user interface displayed on a display device coupled to said host computer, said cursor being controlled by said user by manipulating said handle of said interface device;

associating elements in said graphical user interface with forces affecting said handle based on said location of said user-controlled cursor with respect to said elements;

receiving from said host computer the location of at least one element displayed by said display device and storing said location in memory local to said microprocessor; and

providing a signal to one or more actuators to apply a force on said handle in at least one degree of freedom to impede or direct motion of said handle in said degree of freedom, said force being applied when said cursor interacts with at least one element in said graphical user interface.

68. A method as recited in claim 67 wherein said element is an icon, and wherein said force is an attractive force that assists said user in positioning said cursor on said icon.

69. A method as recited in claim 67 wherein said element is an icon, and wherein said force is an impeding force which impedes said user from moving said cursor off of said icon.

Sub a8

70. A method as recited in claim 68 wherein said element is a vertical menu including a plurality of menu items.

71. A method for providing force feedback to a user interacting with a graphical user interface environment of a computer system, the method comprising:

receiving an indication of movement of a physical object that is manipulated by a user, said physical object being included in a human interface device that outputs said indication to said computer system;

moving a cursor within a graphical user interface, said movement based on said indication of movement of said physical object, wherein said cursor and said graphical user interface are displayed on a display screen coupled to said computer system; and

using an actuator to apply a force in a degree of freedom of motion of said physical object, wherein said force is associated with said interaction of said cursor with said graphical user interface, said force being applied when said cursor is positioned within a preselected distance of a graphical object displayed in said graphical user interface.

72. A method as recited in claim 71 wherein said graphical object is an icon and wherein a force applied to said physical object is an attractive force that draws the cursor towards said icon when said cursor is substantially adjacent to said icon.

73. A method as recited in claim 71 wherein said force is applied to said physical object to resist overshoot of said cursor when the user selects said graphical object.

74. A method as recited in claim 71 wherein said force includes a viscous drag force that is applied when said graphical object is moved.

75. A method as recited in claim 74 wherein said graphical object being moved is the thumb of a scroll bar.

NEW CLAIMS

76. A human-computer interface device for controlling a graphical cursor displayed by a host computer and for providing tactile feedback to a user in accordance with displayed interactions between said cursor and other graphical objects displayed by said host computer, said interface device comprising:

a physical object to be moved by a user in two planar degrees of freedom;

one or more sensors that produce a locative signal responsive to and indicative of the position of said physical object in said two planar degrees of freedom;

an actuator that applies force to the user's hand along a tactile degree of freedom when current is flowed through a portion of said actuator, said tactile degree of freedom being different from said two planar degrees of freedom; and

a microprocessor separate from and in communication with said host computer, said microprocessor coupled to said sensor and to said actuator, wherein said microprocessor receives force information from said host computer and controls current through said portion of said actuator in accordance with said force information.

77. An interface device as recited in claim 76 wherein said two planar degrees of freedom are x and y axes and said tactile degree of freedom is a z axis substantially perpendicular to said x and y axes.

78. An interface device as recited in claim 77 wherein said interface device is a mouse device and wherein said physical handle is a mouse.

79. An interface device as recited in claim 76 wherein said actuator includes a wire coil through which said current is flowed.

80. An interface device as recited in claim 79 wherein said actuator includes a magnet core.

81. An interface device as recited in claim 80 wherein said magnet core is an E-core.

82. An interface device as recited in claim 76 wherein said sensor is an optical sensor.

83. An interface device as recited in claim 82 wherein said sensor is an encoder.

84. An interface device as recited in claim 80 further comprising a permanent spring coupled between said handle and said actuator.

85. An interface device as recited in claim 76 wherein said actuator is controlled to indicate when the cursor displayed on the host computer is moved from one displayed menu element to another displayed menu element.

86. An interface device as recited in claim 76 wherein said actuator is controlled to indicate when the cursor displayed on the host computer crosses a window boundary.

87. An interface device as recited in claim 76 wherein said actuator is controlled to apply said pressure to said user's hand to indicate when the cursor displayed on the host computer is positioned over a graphical element.

88. An interface device as recited in claim 77 wherein said actuator includes a portion that is moveable by said user along a z-axis to provide z-axis control to said host computer.

89. An interface device as recited in claim 76 wherein said microprocessor receives host commands from said host computer and controls current through said portion of said actuator in accordance with at least one of said host commands.

90. An interface device as recited in claim 76 wherein said microprocessor receives host commands from said host computer and calculates forces to be applied to said user.

91. An interface device as recited in claim 90 further comprising memory local to said microprocessor for storing values that are representative of the locations of images displayed by said host computer.

92. An interface device as recited in claim 76 wherein a physical tactile element is coupled to said actuator and is moved to contact and apply pressure to said user's hand.

93. An interface device as recited in claim 92 wherein said physical element applies pressure upon the user's hand by pressing upward on said hand when said current is flowed through said portion of said actuator.

94. A joystick device for controlling a software application running on a host computer and for providing tactile feedback to a user in accordance with said software application, said joystick device comprising:

a joystick handle to be manipulated by a user in two degrees of freedom;

at least one sensor that produces a locative signal responsive to and indicative of the position of said handle in said two degrees of freedom; and

an actuator for applying tactile feedback upon the user's hand, said actuator mounted in the handle of said joystick, wherein said actuator is coupled to a physical element that is moved to contact and apply pressure to said user's hand.

95. A joystick device as recited in claim 94 wherein said actuator includes a wire coil through which a current is flowed.

96. A joystick device as recited in claim 95 wherein said tactile element further includes a magnet core.

97. A joystick device as recited in claim 96 wherein said magnet core is an E-core.

98. A joystick device as recited in claim 94 wherein said sensor is an optical sensor.

99. A joystick device as recited in claim 94 wherein said actuator is controlled to apply pressure to said user's hand to indicate when the cursor displayed on the host computer is positioned over a graphical element.

100. A joystick device as recited in claim 94 wherein said physical element includes a portion that is moveable by said user along a z-axis to provide z-axis control to said host computer.

101. A joystick device as recited in claim 94 further comprising a microprocessor separate from said host computer and coupled to said host computer by a communication bus, said microprocessor also coupled to said sensor and to said actuator.

102. A joystick device as recited in claim 101 wherein said microprocessor receives host commands from said host computer and calculates forces to be applied to said user.

103. A joystick device as recited in claim 101 wherein said microprocessor receives host commands from said host computer and controls a current through a portion of said actuator in accordance with at least one of said host commands, said current causing said pressure to be applied to said user's hand.

104. A joystick device as recited in claim 102 further comprising memory local to said microprocessor for storing values that are representative of the locations of images displayed by said host computer.

105. An interface device for controlling a position of a graphical cursor displayed by a host computer and for providing tactile feedback to a user in accordance with displayed interactions between said cursor and other graphical objects displayed by said host computer, at least one of said graphical objects including a displayed menu having a plurality of menu elements, said interface device comprising:

a physical object to be moved by a user in two planar degrees of freedom;

at least one sensor that produces a locative signal responsive to and indicative of the position of said physical object in said degrees of freedom, said locative signal for use in controlling said cursor displayed by said host computer;

an actuator that applies tactile feedback to the user's hand, said actuator including a magnet and a coil, wherein said actuator is controlled to apply bi-stable tactile feedback to said user that indicates when said cursor moves from one of said menu elements to another one of said menu elements.

106. An interface device as recited in claim 105 further comprising a local microprocessor separate from and in communication with said host computer, said microprocessor coupled to said sensor and to said actuator, wherein said microprocessor receives force information from said host computer, controls said tactile feedback, and transmits position data to said host computer.

107. An interface device as recited in claim 105 wherein said actuator is coupled to a physical member that is moved to contact and apply pressure to said user's hand.

108. An interface device as recited in claim 106 wherein said actuator is controlled by said local microprocessor to apply said tactile feedback when said cursor displayed on said host computer is moved across a displayed window boundary.